Exeter River Unified Stream Assessment
Quality Assurance Project Plan

Prepared by:
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3 Distribution List

The following individuals will receive a copy of this final Quality Assurance Project Plan (QAPP). Individuals requesting a copy for informational purposes only are also to be listed here.

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Field Technicians (seasonal interns)
To be hired

4 Project and Task Organization

This is a site-specific QAPP for stream assessment surveys in the Exeter River. DES is the lead organization for this project. DES staff will manage the project and serve as the quality assurance officer. Interns will be hired by DES to conduct a majority of the work including the field and data entry tasks. The following individuals are involved with this project. Their respective roles and responsibilities are listed. See Section 3 for contact information.

Project Manager and QA Officer
Natalie Landry, DES

Responsibilities
Overall project management, overall QA/QC, intern training, field supervision, and data management.

Field Technicians (seasonal interns)
To be hired.

Responsibilities
Field work, data entry and data QC.

The principal data users will be DES and consultants hired to write the management plans for subwatersheds represented by the stream surveys. The data will be used to identify and prioritize management measures related to the problems documented in the survey. The data will be shared by DES with the Exeter River Local Advisory Committee (ERLAC) and the Exeter River Study Committee.

5 Problem Definition / Background

The Exeter River Watershed area is about 67,700 acres and includes many tributary streams which flow into the Exeter River. The river, which is approximately 32 miles long, flows over the Great Dam in Exeter into the tidally-influenced portion of the river called the Squamscott River. The river is a primary tributary to the Great Bay Estuary. The watershed runs through ten towns in Rockingham County which are Chester, Sandown, Danville, Fremont, Raymond, Brentwood, East Kingston, Kingston, Kensington, and Exeter.

The DES Watershed Management Bureau's Strategic Plan (Currier, 2002) called for the design and implementation of a statewide watershed approach to protect and restore surface waterbodies. Since only about 8% of New Hampshire's river miles are assessed for designated use support, surrogate measures of watershed health were required to prioritize protection and restoration efforts. The assessments occurred at the Hydrologic Unit Code (HUC) – 10 scale. Existing information available through Geographic Information Systems (GIS) allowed for a standardized approach. The assessment categorized the Exeter River Watershed (HUC 0106000308) as in need of Restoration. DES defines a watershed in need of Restoration as a watershed with multiple types of problems best resolved by the creation of a public/private watershed management team to develop a watershed management plan for the resource.

Based on the DES assessment, ERLAC, RPC and DES formed a partnership to identify subwatersheds in the Exeter River watershed in need of immediate protection planning and those in need of restoration. This will be accomplished through a watershed vulnerability analysis. Based on the results of the analysis, subwatershed management plans will be created for high ranking subwatersheds in either the

protection or restoration category. A watershed vulnerability analysis requires various types of data and information such as current and future land use, significant environmental features, water quality standards violations and nonpoint sources of pollution (Zielinski, 2002; CWP, 2002). In 2005, a report was produced (Fardy and Landry) that identified what data are available and what agency houses the data needed for the vulnerability analysis. Typically, the data were in a GIS-format. Information on nonpoint sources of pollution in the watershed was scarce and dated.

A major objective of the Exeter River Unified Stream Assessment (USA) is to survey and identify impacts from nonpoint source pollution such as stormwater outfalls, severe erosion, impacted stream buffers, trash and debris, utility impacts, stream crossings, channel modifications, and other notable features. These problem sites will be used for the development of the subwatershed management plans that are selected for creation through the vulnerability analysis ranking. Three subwatersheds will be selected. To work towards this objective, the following tasks have been identified and will be addressed in this QAPP:

- Pre-field preparation;
- Stream corridor assessment;
- Quality control; and
- Data interpretation.

The field crew walks the selected surface stream and its flood plain corridor during the USA to map, locate and collect basic data on significant impacts. The survey helps identify and screen potential project locations that can be subsequently investigated using other detailed assessment methods (Kitchell and Schueler, 2004).

6 Project Description

The Unified Stream Assessment (USA), created by the Center for Watershed Protection, provides a comprehensive picture of stream conditions and restoration opportunities available in the stream corridor of small watersheds. The survey data is collected by DES staff and will be used by RPC and ERLAC in the subwatershed management planning. DES will use the methodology described in the *Unified Stream Assessment: A User's Manual* (Kitchell and Schueler, 2004), with some exceptions. The major exception is the elimination of the stream reach survey. The surveys in the Exeter River subwatersheds will focus on the eight impact assessments with the purpose of generating an inventory of potential restoration opportunities. Minor exceptions are noted on the field data sheets and in Section 9. The USA is being used because it is inexpensive, fast, identifies problems in the stream corridor, and helps to assemble an initial inventory of stream corridor restoration sites such as discharge investigations, stream daylighting projects, stormwater retrofits, bank stabilization, buffer reforestation, culvert repair and stream clean up sites.

The sampling season is scheduled for late winter through summer 2007.

Table 1 Project Timeline

	2007						
Major Tasks	**F**	**M**	**A**	**M**	**J**	**J**	**A**
QAPP Preparation	X						
Pre-Field Preparation		X	X	X			

Stream Assessments			X	X	X		
Quality Control Checks				X	X	X	
Data Interpretation					X	X	
Data Report to ERLAC and Consultant							X

7 Task Description

The project tasks are show in Table 2 and described in further detail below.

Table 2 Unified Stream Assessment Steps

Step	Tasks
1. Pre-field preparation	Train interns Get supplies in order Define survey reaches based on selected subwatersheds Generate field maps Plan assessment route & schedule
2. Stream corridor assessment	Check routes and equipment Perform site impact and reach assessments Debrief and check field forms
3. Quality control	Enter data into MICROSOFT Excel Spreadsheet Quality control check Identify field assessment gaps
4. Data interpretation	Generate maps and metrics Generate inventory of restoration opportunities
5. Reporting	Write report for ERLAC and RPC.

Adapted from *Unified Stream Assessment: A User's Manual* (Kitchell and Schueler, 2004), Page 8.

Task 1: Pre-field Preparation

Interns are trained in completing the survey forms, field equipment and safety. The Project Manager walks both a highly impacted stream reach and a stable undeveloped stream reach with the interns to help standardize data gathering. The interns are exposed to examples of various restoration practices through field trips to restored sites, internet searches and publications in the DES Watershed Assistance Section library. Schedules and routes are established based on reconnaissance of the stream segments in the selected subwatersheds and access. The local police are notified prior to the survey as well as any mobile home park offices that are in the survey area.

Task 2: Stream Corridor Assessment

As described in Kitchell and Schueler (2004), the field crew starts at the downstream end of the survey reach and walks up the stream corridor, noting overall bank and channel stability, riparian vegetation and other impacts. As individual impact sites are encountered, the crew photographs the site and completes the appropriate assessment form including locating the site using GPS field meter. If multiple impacts to the river occur at a single site, an individual form is completed for each distinct problem. For tracking purposes, the location and ID number for each problem site is based on the DES Assessment Unit number, which is based on HUC12 watersheds. See Section 10 for details. Convention is to face downstream when determining problems for the left and right stream bank. Each field day ends with the

crew meeting to solve any logistical problems and measuring and recording consistency. The Project Manager reviews field sheet for completeness and accuracy. Illegible handwriting is neatened, and photos and GPS waypoints accurately cross-referenced. Interns are encouraged to use ink to document all field data and information (field measurements, station descriptions, etc.). However, documents completed with pencil or other erasable media are acceptable. Interns are also encouraged to correct all recording errors by placing a single horizontal line through the error, recording the new data next to or above the erroneous record(s), and initialing the correction. Field forms are organized in a master binder at the end of the debriefing.

Task 3: Quality Control

At the DES Pease Field Office, the information on the field data sheets is entered into a Microsoft Excel spreadsheet. The field crew enters their data immediately after fieldwork is complete. Data entry for each field form is checked by the Project Manager. Draft stream corridor maps with site impact assessment locations are generated by the DES GIS staff and are distributed to all field staff for review. Spreadsheets and maps are considered final after review by the Project Manager.

Task 4: Data Interpretation

The data are used to determine where problems areas exist. The data are also used to derive various metrics of subwatershed characteristics. These are expressed as occurrences per stream mile. The metrics calculated are outfall density, suspect outfall density, % of network with impacted buffer, road crossings/mile, % of network channelized, and potential fish barriers/mile. The metrics are used to compare restoration potential among reaches and to define initial restoration strategies.

Task 5: Reporting

A report is prepared for ERLAC and RPC that will be used for the subwatershed management plans. The report has the data organized in the following sections: maps of stream problems (suspect outfalls, potential fish barriers, etc) and maps of candidate restoration projects (stream repair, clean up sites, etc.). Segment metrics, based on the number of occurrences per stream mile surveyed, are listed for each surveyed segment.

8 Data Quality Objectives and Criteria

Representativeness

All developed survey reaches in the three select subwatersheds are surveyed using the USA survey methods. Beginning with urban areas, assessments will be carried out on all tributaries in the subwatersheds. The extent to which an area is urbanized will be identified using impervious cover maps of the area provided by GeoSyntec. Also, Arc View Maps developed from GRANIT Data will be used to identify and assess all streams in the subwatersheds, including a complete range of tributaries.

Measurement Consistency

The field crew will be using a Lufkin 100ft Ny-Clad measuring tape and a Lufkin 6ft Extension Rule both provided by DES. The same pieces of field equipment are brought into the field each day.

Comparability

One of the ways that the USA survey ensures comparability is to follow the protocol established by the CWP in the USA Manual. Field crews use standardized field forms for each impact site. Some of the assessment variables associated with the CWP protocols are qualitative. For the subjective assessments such as impact severity, for example, the field crew uses the descriptions provided with the ranking scheme to select a rank for the qualitative parameter. At the end of the day's activities, the team will compare notes, discuss the parameters and come to a consensus on the subjective scores.

Completeness

There are no legal or compliance uses anticipated for the USA data. In addition, there is no fraction of the planned data that must be collected in order to fulfill statistical criteria. It is expected that stream surveys will be completed from the top three priority subwatersheds, unless unanticipated weather conditions prevent surveys. All tributaries will be assessed and stormdrain system maps provided by Exeter Department of Public Works will be used to compare the stream corridor discharge pipes assessed in the field and recorded on the maps.

9 Training Requirements

Training of interns is required for stream survey data collection, data entry, and quality control procedures. The requirements are itemized in Table 3. The Project Manager maintains a spreadsheet that includes names of trained interns and the date of training. This spreadsheet serves as a certification of training. Successful verification of the Interns work, in the field will serve as a check on the training success.

Table 3 Summary of Training

Project function	Description of Training	Training Provided by	Training Provided to
Survey Data Collection	Explain and practice field preparations and completing field forms. View examples of impacts and restoration in the field.	Project Manager	Interns
Data Entry	Explain and practice entering data into spreadsheet.	Project Manager	Interns
Quality Control	Explain and practice checking entered data.	Project Manager	Interns

10 Documents and Records

The Project Manager will be responsible for ensuring that project personnel have the most current version of the QAPP and field data forms. Forms for the stream surveys are from the USA Manual with some modifications. USA survey field forms for the Exeter River surveys are in Appendix A. Interns keep

field data sheets in a one-inch binder for field work and file the forms into a 3" binder in the Pease Field office. Field forms are filled out for each impact site.

Once all fieldwork is completed, information on the field forms are transferred to computer files in the DES Pease Field Office only after the Project Manager has inspected and signed off on each individual field form. Although that information will be transferred to computer format, all field forms are kept on file to ensure that the data are always available in two forms. This computerized information is provided to RPC for subwatershed management planning. DES staff will keep a complete set of training and field forms at the Project Manager's office for a minimum of three years.

11 Survey Design (Experimental Design)

Each impacted site is documented through the use of one of the eight field forms depending on what is observed in the field and the procedures in the USA Manual. The following information describes the various impacts and the questions to be answered at each site. Limitations and suggestions for completing the various forms are also included. Specifics and required equipment and supplies are described in Section 10.

Stormwater Outfalls

The USA survey assesses all stormwater outfalls and other pipes that discharge to the stream corridor. Specifically, the survey documents suspected illicit discharges, enclosed pipes for potential daylighting, off-line storage retrofits, and local opportunities to stabilize or repair streams and outfalls. The following questions are answered during the survey at each stormwater outfall impact site: What is the general condition of the outfall? Is there flowing discharge? If so, what are the characteristics of that flow? Is there any noticeable stream or bank erosion near the outfall? Is this outfall a candidate for retrofitting or daylighting?

All outfalls with a diameter of six inches or greater will be assessed. The following types of outfalls are not assessed: Drop inlets from roads in culverts, cross-drainage culverts in transportation right-of-ways (i.e., can see through other end) and weep holes. The survey field form is identified at "OT."

Severe Erosion

The USA survey assesses the most severe eroding banks along the survey reach. Basic data about each severely eroded site is recorded including location, estimate of current channel dynamics and dimensions, and potential bank stabilization opportunities at each problem site. Since bank erosion is expected in most urban streams, slope failures, bank sloughing, incision, or channel enlargement is only recorded for banks that are noticeably worse than the "average" eroded bank along the survey reach. Sites with average bank erosion are only counted if adjacent infrastructure is threatened or significant property loss is evident. Streamside headcuts and channel nick points with elevation changes of at least two feet are always recorded, since they signal active channel erosion is migrating upstream. The following questions are answered during the survey at each severe erosion site: Is this area more severe than the rest of the survey reach? Is infrastructure or property threatened? What appears to be the cause of the erosion? Are the banks activities contributing sediment to the stream? Is this site a candidate for bank stabilization or grade control?

If the eroded bank is less than 100 feet long, GPS cannot calculate an accurate length, and the length is measured with a tape measure. A table from the USA Manual that lists the features used to determine

current channel process is located in the "Severe Erosion" section of the field 3-ring binder for reference by field staff. And, a sketch from the USA Manual that shows how to measure basic stream dimensions, such as bank height and angle, bottom width, and channel wetted width is also in the binder. The survey field form is identified at "ER."

Impacted buffer

The USA survey assesses impacts to the riparian buffer observed during the stream survey. Basic information is documented such as the location and quality of the buffers, along with adjacent wetland restoration and reforestation opportunities at each site. The following questions are answered during the survey at each impacted buffer site: Why is this buffer considered inadequate? What is the adjacent land use and how does it impact the buffer? What is the density and diversity of vegetative cover (grass, shrub, woody)? Are invasive plant species present? What kinds of reforestation opportunities exist?

Riparian areas with buffers less than 50' in width are considered inadequate (based on the NH Comprehensive Shoreland Protection Act minimum for not removing stumps and maintaining a natural woodland buffer within 50' of the water). In addition, only inadequate buffers of greater than 100' in length are to be documented. Only riparian areas meeting these criteria are documented. An exception is a riparian area overgrown with invasive plant species. The extensive presence of invasive plant species can threaten an otherwise healthy buffer system. Field staff uses the *Guide to Invasive Upland Plant Species in New Hampshire* (undated) as a reference, which is in the field binder. Field staff brings along tools (e.g. clippers) to make way through dense thickets of invasive vines and shrubs. The survey field form is identified at "IB."

Utilities in the Stream Corridor

The USA survey assesses all locations where utilities cross the stream corridor and can cause water quality, stream habitat, or channel stability problems. This includes manhole stacks, sewer or water lines, or rights-of-way. The following questions are answered during the survey at each utilities site: How is the utility impacting the stream corridor? Are there any maintenance issues that should be reported? Is there evidence of any sewer leaks or recent overflows? What kind of utility repair would I suggest here?

Any spills or leaks observed during the survey are reported to authorities listed on contact list in the 3-ring binder. The survey field form is identified at "UT."

Trash and Debris

The USA survey assesses all locations where trash and debris are dumped or have accumulated. The field crews notes trash/debris in the stream, dumping in the stream corridor and hazardous materials. The following questions are answered during the survey of trash and debris: Is this area trashier than the rest of the survey reach? What kind of trash is it, and is it hazardous? Is there an illegal dump, or other obvious source? What level of effort will it take to clean this up?

Every piece of trash is not recorded; rather field crews note areas where trash and debris have accumulated well above the average level observed for the reach, or where potentially hazardous or unknown chemical containers are found. If trash is a known or potential hazard, authorities will be notified. A list of contact numbers is in the front of the field binder. Field crews note the presence of poison ivy or other hazards (e.g., traffic or deep, fast flowing water) that may limit volunteer cleanups to older teens and adults. The survey field form is identified as "TR."

Stream Crossings

The USA survey assesses all locations where structured crossings occur within the stream corridor, which can include bridges, culverts, railways, and dams. The field crews note potential fish barriers, culverts in need of repair or replacement, opportunities for upstream storage retrofits, or associated stream repair projects at each crossing. The following questions are answered during the survey at each stream crossing site: What impacts is the crossing having on the stream? Is this a potential fish barrier? Is there any maintenance or flooding concerns related to the crossing? Is this crossing a candidate for removal or retrofitting?

The stream crossings are evaluated for their use of grade control. Their interference with fish migration may be reported to New Hampshire Fish and Game for future restoration projects. Assessments also take into account both wet and dry seasons to ensure that low stream flows as well as floodwaters can be accommodated by the stream crossing. The survey field form is identified as "SC."

Channel Modification

The USA survey assesses the extent to which stream channels are modified within the urban stream corridor. Examples of channel modifications include channelization, bank armoring, channel lining, and flood plain encroachment. The following questions are answered during the survey at each channel modification site: How severely is this modification affecting stream corridor habitat? What is the length and purpose of the modification? Can softer bank stabilization methods be used? Can a more natural channel design be employed?

Field crews will be specifically looking for channel segments that may need structural repair or present opportunities for a more natural stream channel design. Only "hard" channel modification longer than 50 feet will be assessed. Any channel modifications that are immediately associated with structured stream crossings will not be counted unless they extend 100 feet above or below the crossing. The survey field form is identified as "CM."

Miscellaneous Features

The USA survey tracks any unusual impact or notable feature encountered during the stream walk that cannot be assessed using any of the other impact forms. This form is used to record high quality habitats or rare biota in the stream corridor, grade control that could influence stream restoration, disturbances in the stream corridor, impacts from agricultural practices, or in-stream water quality problems that may warrant further investigation. The miscellaneous features form is also used to track stream and flood plain features that do not fit into one of the other seven impact forms. The survey field form is identified as "MI."

12 Survey Methods

Each impact site has an associated field form that is completed by the field staff. Field forms are kept in a 1" binder for field work and the binder is kept in the field backpack. Assorted pens are kept in the field backpack along with supplies and equipment listed in the last column in Table 4.

The subwatershed names are the eleven subwatersheds identified by the Exeter River Local Advisory Committee in their publication, the *Exeter River Natural Resources Inventory* (Lindley-Stone and Rubin,

1998). The survey reach ID is created by using the 16 character DES Assessment Unit identification number. Each DES Assessment Unit ID begins with NHIMP, NHLAK, or NHRIV to identify impoundments, lakes or rivers, respectively. The reach ID for the surveys eliminate the "NH" and only use one letter (I, L, or R) to identify the waterbody type. And, the reach ID uses the last five numbers in the Assessment Unit ID to identify the Exeter River subwatershed in which the survey reach lies. For example, the Assessment Unit ID for the Little River-Scammen Brook reach in the Little River-North subwatershed is NHRIV600030804-11 and the survey reach ID for this project is R80411.

The site ID numbers for this project will all begin with the site assessment abbreviation noted on the field data sheets and Table 4. For example, stormwater outfall site ID's will all begin with "OT." A three digit number will follow each two letter abbreviation and a "-." All numbers are tracked in the small field three-ring binder at the beginning of each section in the binder. For example, the third outfall pipe found during the survey would be identified as "OT-003." And the 20th stream crossing would be identified as "SC-020."

The Project Manager is responsible for checking problems with the field forms. If data are unclear during the verification step, the Project Manager speaks with the Interns to clarify the data in question. If the Project Manager does not clarify the problem using this method, she field checks the information and modifies the field form, if necessary.

Table 4 Stream Impact Assessments and Methods

Impacts	Assessment Field Form Parameters	Supplies/ Equipment
Stormwater Outfalls (OT)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Latitude and Longitude, GPS unit ID	GPS
	Bank (right or left facing downstream)	None
	Pipe type, material, shape, dimensions, submerged	Tape measure
	Flow, condition, odor, deposits/stains, vegetation density, benthic growth, pool quality	None
	Potential restoration candidate, outfall severity, sketch	None
Severe Erosion (ER)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Start and end Latitude and Longitude, GPS unit ID	GPS
	Erosion process	List in binder
	Bank (right or left facing downstream) and dimensions	Tape measure and instruction sketch
	Land ownership	Maps
	Potential restoration candidate, threat to property/infrastructure	None
	Existing riparian width	Tape measure
	Erosion severity and access	None
	Notes and sketch	None
	Subwatershed, survey reach ID and site ID	Maps

Impacted Buffer (IB)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Start and end Latitude and Longitude, GPS unit ID	GPS
	Impacted bank, reason inadequate	none
	Land use	Maps
	Dominant land cover	None
	Invasive plants	Invasive species guide & tools
	Stream shade provided	None
	Potential restoration candidate, restorable area	Tape measure
	Reforestation potential, potential conflicts w\reforestation, notes	None
Utilities (UT)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Latitude and Longitude, GPS unit ID	GPS
	Utility type, material, location, condition	None
	Potential fish barrier, water drop, pipe diameter	Tape measure
	Evidence of discharge, potential restoration candidate	None
	Utility impact severity, notes	None
Trash and Debris (TR)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Latitude and Longitude, GPS unit ID	GPS
	Type of land use, material observed, source, location, land ownership, amount	None
	Potential restoration candidate, clean up potential, notes	None
Stream Crossings (SC)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Latitude and Longitude, GPS unit ID	GPS
	Type, shape, material, alignment, condition, dimensions	Tape measure/ List in binder
	Potential restoration candidate, use of grade control	None
	Extent of physical blockage, cause of fish barrier, water depth and drop, blockage severity	Tape Measure

Channel Modification (CM)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Type, material, dimensions	Tape measure
	Base flow channel, information in adjacent stream corridor	Tape measure

	Potential restoration candidate, channelization severity	None
Miscellaneous Features (MI)	Subwatershed, survey reach ID and site ID	Maps
	Date, time and survey personnel	None
	Photo ID	Camera and photo log
	Potential restoration Candidate	None

13 Sample Handling and Custody

Global Positioning System (GPS) data will be collected at each impact site and those data are recorded on field forms. Field forms will be labeled to keep track of each site survey. Photo numbers will be placed on the field form and the photo inventory sheet. A blackboard and chalk will be used at each photo site to identify location, date, time, and any notes in accordance with the *DES Photo Documentation Procedure for Measuring the Success of Restoration Projects and Best Management Practices*. The blackboard will be visible in each photo. This protocol will facilitate accurate photo file downloads and improve reporting validity. The Field Technicians will deliver the field forms to the office in the small binder. The Project Manager will review the forms as described in Section 22 and the field technicians will enter the data into the computer. Either the Project Manager or the Field Technician who did not enter the data originally, will check the data entry.

14 Analytical Methods

There are no laboratory or field analyses associated with this project.

15 Quality Control

The most challenging aspect of this project is to organize, process, and translate a huge amount of data with effective quality control procedures. A system is used to manage the data to create usable outputs and formats that feed into the subwatershed management planning efforts. Hundreds of field forms are used which produce a large amount of raw data that characterize the potential and actual stream impacts. The following steps describe the field quality control procedures.

1. The field crews use existing field forms to document stream impact conditions. Multiple blank copies of each type of field form are organized into a 1" three-ring binder. Emergency contact information is taped to the inside cover of the binder.
2. Enough blank forms for the day's work are placed into the 1" binder prior to driving to the site. Blank field forms are in Appendix A. All forms have the quality control information on the bottom of the form. This information includes space to initial and date four steps in the quality control process and they are data validation, data verification, date entered and data checked.
3. At the end of each day, the field team regroups to discuss the survey progress. The Project Manager confirms that all survey reaches have been surveyed, discusses initial findings, and deals with any logistical problems.
4. The Project Manager reviews the field forms for accuracy and thoroughness. Illegible handwriting is neatened and details added to notes. And, the Project Manager makes sure all site impacts, reach IDs, GPS waypoints and photo numbers are properly cross-referenced. See Section 20 for more details on data management and Section 22 for Validation and Verification details.

16 Instrument and Equipment Testing, Inspection, and Maintenance

The hand-held GPS unit has a minimum horizontal accuracy of 3 meters. The GPS unit must be turned on for a minimum of 15 minutes before data collection begins, to ensure the current satellite almanac has been transmitted and received by the unit. A minimum of five satellites are required for an accurate reading. If less than five satellites are detected, a GPS point is not recorded. The site or sites are revisited during the next field day for recording a GPS point at each site. Sites are plotted and spatially checked using a Geographic Information System (GIS) computer mapping program (ArcView). Waypoints are measured in decimal degrees as required by DES protocols.

17 Instrument and Equipment Calibration and Frequency

None.

18 Inspection and Acceptance of Supplies and Consumables

All supplies, including the GPS, will be checked regularly by the Field Technicians. The contents of the field backpacks are checked before each field day to make sure that all supplies and equipment are in the packs. And, after each field day, the contents are checked to make sure nothing is broken and needs to be replaced. The camera batteries and the GPS meter are placed on charging units.

19 Non-direct Measurements

Maps of the streams and watershed were created from GIS data obtained from DES and from NH GRANIT sources. These maps will be used to supplement land use observations obtained in the field. In addition, the maps and data coverages will be used to select Assessment Units (AKA survey reaches). It is possible that field conditions will differ from the map information due to inaccuracies of map data, scale resolution or development that post-dates the map information.

20 Data Management

Interns are encouraged to use ink to document all field data and information (field measurements, station descriptions, etc.). However, documents completed with pencil or other erasable media are acceptable. Interns are also encouraged to correct all recording errors by placing a single horizontal line through the error, recording the new data next to or above the erroneous record(s), and initialing the correction.

Survey Data

Field forms are reviewed by the Project Manager. The field crews use existing field forms to document stream impact conditions. The forms are attached in Appendix A. All forms have the quality control information on the bottom of the form. This information includes space to initial and date four steps in the quality control process and they are data validation, data verification, date entered and data checked.

All data on the field forms will be entered into a computerized Microsoft Excel spreadsheet at the DES Pease Field Office. The data entry person will initial and date the appropriate space on each form. The computerized data will be checked by at least one other person as a form of quality control. The QC check person will initial and date the form in the appropriate space.

The Pease Office is maintained on the DES computer network, which is secured through daily back-up procedures. Charts, tables, figures, and descriptive statistics are generated using Microsoft Excel.

21 Assessments and Response Actions

Attention to quality is a primary consideration of the project. The Project Manager formally reviews the performance of the interns at times during the survey to ensure proper data collection. All personnel associated with the project will ensure that the survey procedures are followed closely. Training, maintenance and field records will be filled out in a timely manner.

GPS equipment errors may occur and must be accounted for by reporting them to the Project Manager. If the error is identified before the survey takes place, the equipment will be labeled as broken and will be replaced by properly working equipment, if available. If malfunctioning equipment affects the data, the equipment will be recorded as such on the field data sheet and immediately reported to the Project Manager.

The Project Manager is ultimately responsible for oversight of all activities of the data collection process. The Project Manager ensures that field team members are performing all data collection as prescribed by the quality assurance project plan. All field activities may be reviewed and project sites may be visited by DES and USEPA quality assurance officers as requested.

22 Verification and Validation Requirements and Methods

All field data are verified and validated. The field data collection and data entry activities are subject to verification and validation reviews by the Program Manager and field technicians.

Validation

Validation reviews are conducted internally on a daily basis. Validation reviews for field-generated data are conducted at the end of each survey day, where the Program Manager reviews field forms. The Program Manager screens the data, and discusses any issues with field technicians. If errors are found, they are corrected before computer data entry begins. If consistent errors are found, re-training on the particular issue occurs before the next field day. The Program Manager validates the data collected for that particular day by signing the bottom of the field forms in the validation space at the conclusion of each survey day.

Verification

Throughout the survey project, verification reviews for field-based activities are conducted by the Program Manager to ensure data are collected in accordance with this QA Project Plan. This is achieved through the use of a verification checklist created by the Program Manager, which includes proper documentation of GPS waypoints, documentation of data collected during surveys, and appropriate reconciliation of documentation errors made during field activities. Refer to table 5 for the verification process.

Table 5 Data Verification Process

Verification task	Description	Person responsible for verification (name, organization)
Sampling Design	Conformance to the survey design is verified daily. This includes a comparison of the survey activities planned for the day against the sampling activities actually conducted. Any inconsistencies are discussed and reconciled prior to the subsequent survey day if the subsequent survey day is impacted by the inconsistency. If inconsistencies are found, a verification review memo is completed, and retained in the field binder.	Project Manager DES
Field Data Sheets	Field data are verified daily according to this QA Project Plan, where completeness is the primary concern. The verification review is conducted at the end of the survey day, and ensures that field data are appropriately documented on the field forms, and that documentation errors are properly reconciled. Requisite corrective actions are imposed prior to the subsequent sampling day.	Project Manager DES

Any decisions made regarding the usability of data will be ultimately left to the Project Manager; however the Project Manager may consult with the QA Officer, project personnel, DES QA staff, or with personnel from USEPA.

When it is found that data do not meet the quality objectives or do not adhere to the quality control measures, the Program Manager may determine what corrective action must be taken. Incomplete data may lead to the need for re-assessment of particular reach if it is found that the available data are insufficient to meet project goals. When data quality is poor, the Project Manager may choose to have DES staff re-assess or verify the measurements in question, or reject the data with a written explanation.

Equipment inspections occur regularly by the Field Technicians to ensure that equipment is in proper working order. If a piece of equipment is found to have a problem, qualified staff verifies the problem before corrective actions are taken.

23 Reports to Management

Routine QA Management Reports are not necessary for this short-term project. A QA memorandum is written at the conclusion of the project. This memorandum summarizes the QA activities conducted, including:

- Summary of QA/QC objectives;
- Description of training activities;
- Conformance to QAPP requirements/procedures, descriptions of deviations, if any, from the approved QAPP, and approved amendments, if any, to the QAPP;
- Limitations of data;
- Documentation of usable data versus amount of data actually collected;
- List of reasons why data are not usable;

- Summary of conflicts, and subsequent resolution of conflicts, associated with sampling; and
- Use and effectiveness of corrective actions, if corrective actions were taken.

Copies of the memorandum are retained in the DES Pease Office files and on the DES Watershed Management Bureau H drive. Copies are also transmitted to the DES Quality Assurance Manager.

A report will be produced by the Project Manager and distributed to Project partners by the end of June 2007. The final report on the program will include all of the accepted data, explanations for unaccepted data, an analysis, and any other important information the organizers of the program feel is appropriate. The report will credit everyone who has worked on the program and provide a bibliography of resources used.

24 Data Review, Verification, and Validation

All field data are reviewed by the Project Manager to determine if the data meet QAPP objectives. The data are scrutinized in the context of the data quality objectives. A decision is made whether to accept, qualify of reject the data. Decisions to reject or qualify data are made by the Project Manager.

25 Reconciliation with User Requirements

In situations where the GPS equipment has been shown to be faulty it is replaced or another method is found. If it is shown that better training is required, the Project Manager may request additional support from DES staff to ensure that training is completed properly.

Limitations in the USA survey data will be clearly defined for potential end users in all reports produced. If the project objectives from Section 8 are met, the user requirements have been met. If the project objectives have not been met, corrective actions, as discussed above, are initiated by the Project Manager.

If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised. Revisions are submitted to the state and USEPA quality assurance officers for approval.

26 References

Kitchell, Anne and Tom Schueler. 2004. Urban Subwatershed Restoration Manual No. 10 Unified Stream Assessment Manual, Version 1.0. Prepared for the Office of Watershed Management, US Environmental Protection Agency, Washington, D. C.

Lindley-Stone, Amanda and Rubin, Fay. 1998. Exeter River Natural Resources Inventory. Audubon Society of New Hampshire and UNH Complex Systems Research Center.

Zielinski, Jennifer. 2002. Watershed Vulnerability Analysis. Center for Watershed Protection. Ellicott City, MD.

27 Appendix A: Field Survey Forms